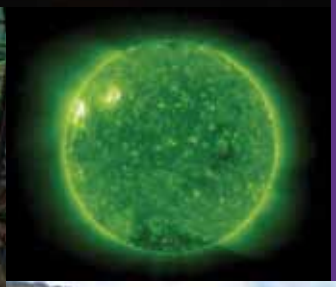
National Aeronautics and Space Administration

FY 2009 Performance and Accountability Report

Management's Discussion and Analysis



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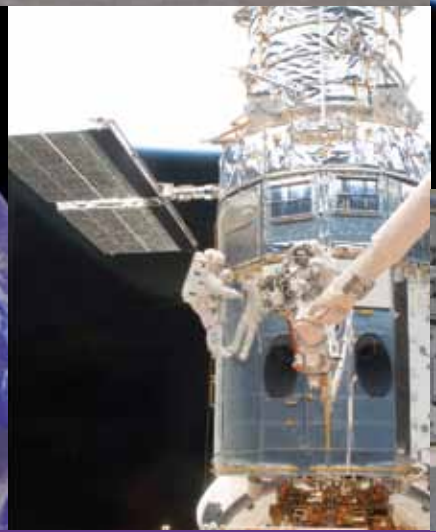


Message from the Administrator

November 16, 2009

I am pleased to present NASA's Performance and Accountability Report for FY 2009. This report presents NASA's progress toward achieving the challenging mission of space exploration, scientific discovery, and aeronautics research as outlined in our Strategic Plan. The performance and financial information presented in this report highlights our efforts to manage taxpayer dollars responsibly, while adhering to NASA's core values of Safety, Integrity, Teamwork and Excellence.

One of our most exciting accomplishments this year was the fourth and final Hubble Space Telescope orbiting observatory servicing mission. The crew of the Space Shuttle Space Transportation System-125 conducted five spacewalks to extend the life of the orbiting observatory and replace aging science instruments. Hubble has given our Nation and the world an unprecedented glimpse into the universe for nearly 20 years and the recent servicing mission ensures that Hubble will continue to provide that unique point-of-view for years to come.

This year, NASA launched missions to observe and better understand the Moon, search for new worlds, and help us understand Earth's climate systems. Our aeronautics program announced a clean-fuel prize, and won a prestigious award for its work in aviation safety. The International Space Station doubled our permanent human presence in space, and our Space Shuttle program safely flew five successful missions.

NASA makes every effort to ensure that performance data are subject to the same attention to detail as is devoted to our scientific and technical research. With this in mind, I can provide reasonable assurance that the performance data in this report is reliable and complete. Any data limitations are documented explicitly in the report.

In addition, NASA accepts the responsibility of accounting for and reporting on its financial activities. In FY 2009, NASA resolved one of the two prior year internal control material weaknesses. The successful resolution of the prior year material weakness in Financial Systems, Analyses, and Oversight resulted from improvements achieved through rigorous adherence to the Comprehensive Compliance Strategy, NASA's framework for ensuring compliance with Generally Accepted Accounting Principles and other financial requirements. The Agency also continued to make significant progress on NASA's one remaining material weakness–Controls over Legacy Property, Plant and Equipment (PP&E), related to valuation of legacy assets. The Agency believes it has now achieved compliance with the applicable updated accounting standard issued in October 2009 with respect to this class of assets. However, due to the fact that the new standard was issued subsequent to the end of the fiscal year, the material weakness in Controls over Legacy PP&E continues, as such, I am unable to provide reasonable assurance that this report's financial data is entirely reliable and fully complete. The Agency's efforts to address this weakness are discussed in the Statement of Assurance section of this report.

During my confirmation hearing, I spoke at length about challenge and leadership. I believe that NASA is an exceptional resource for this Nation, and have set a challenge for myself, as the new Administrator, to find innovative ways to use NASA's missions to enhance our nation's educational, scientific and technological capacity.

I look forward to leading the Agency through this exciting time of transition.

Charles F. Bolden, Jr.
Administrator

Management's Discussion and Analysis

Welcome to NASA

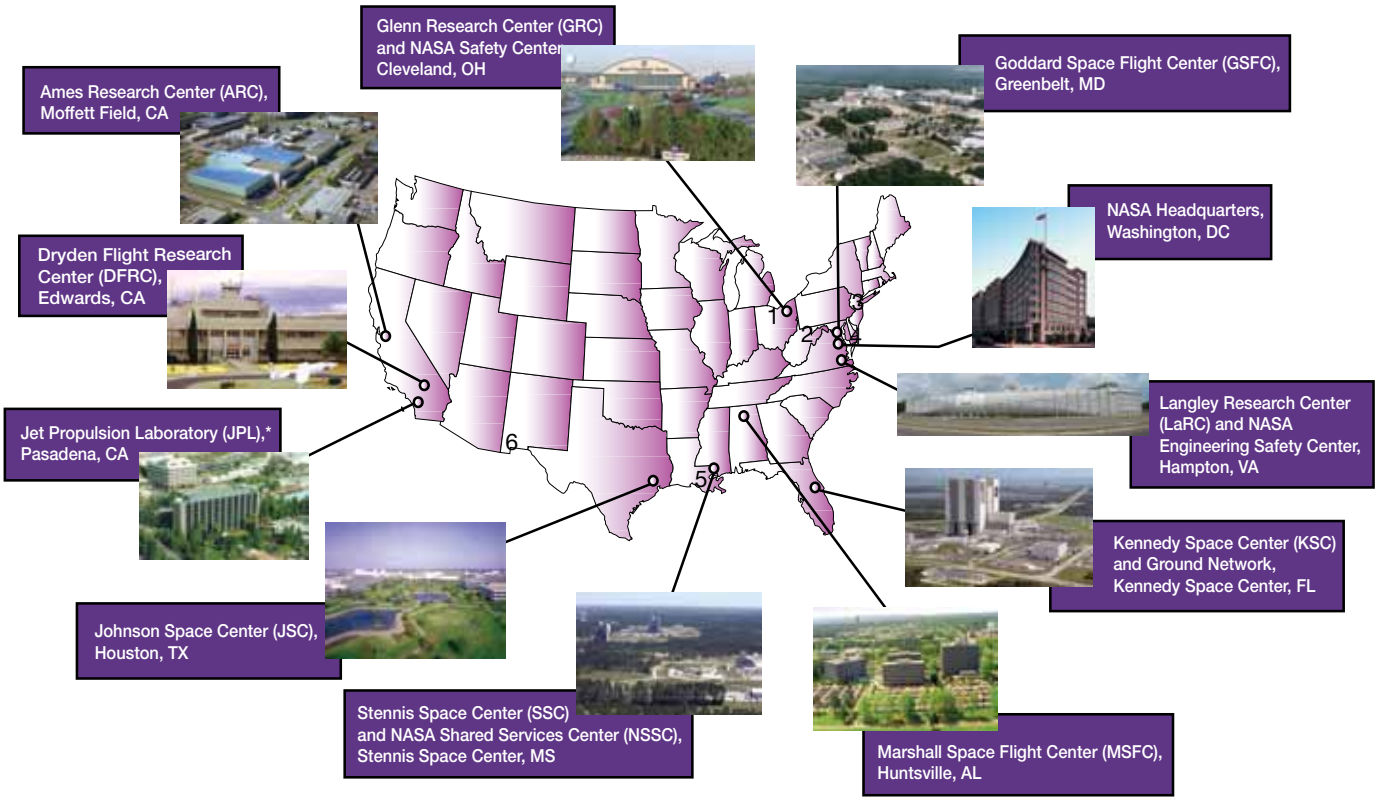
Our Mission

Congress enacted the National Aeronautics and Space Act of 1958 to provide for research into problems of flight within and outside the Earth's atmosphere and to ensure that the United States conducts activities in space devoted to peaceful purposes for the benefit of mankind. Our mission is:

To pioneer the future in space exploration, scientific discovery and aeronautics research.

NASA's Organization

NASA is comprised of its Headquarters in Washington, D.C., nine Centers located around the country, and the Jet Propulsion Laboratory, a Federally Funded Research and Development Center operated under a contract with the California Institute of Technology. In addition, we have partnership agreements with academia, the private sector, state and local governments, other Federal agencies, and a number of international organizations, creating an extended NASA family of civil servants, contractors, allied partners, and stakeholders.



*The Jet Propulsion Laboratory is a Federally Funded Research and Development Center, NASA-owned and managed under the terms of a contract with the California Institute of Technology. The workforce are employees of the California Institute of Technology.

Other NASA facilities include: 1 Plum Brook Station, Sandusky, OH, managed by GRC; 2 Software Independent Verification and Validation Facility, Fairmont, WV, managed by GSFC; 3 Goddard Institute for Space Studies, New York, NY, managed by GSFC; 4 Wallops Flight Facility, Wallops, VA, managed by GSFC; 5 Michoud Assembly Facility, New Orleans, LA, managed by MSFC; and 6 White Sands Test Facility and Space Network, White Sands, NM, managed by JSC.

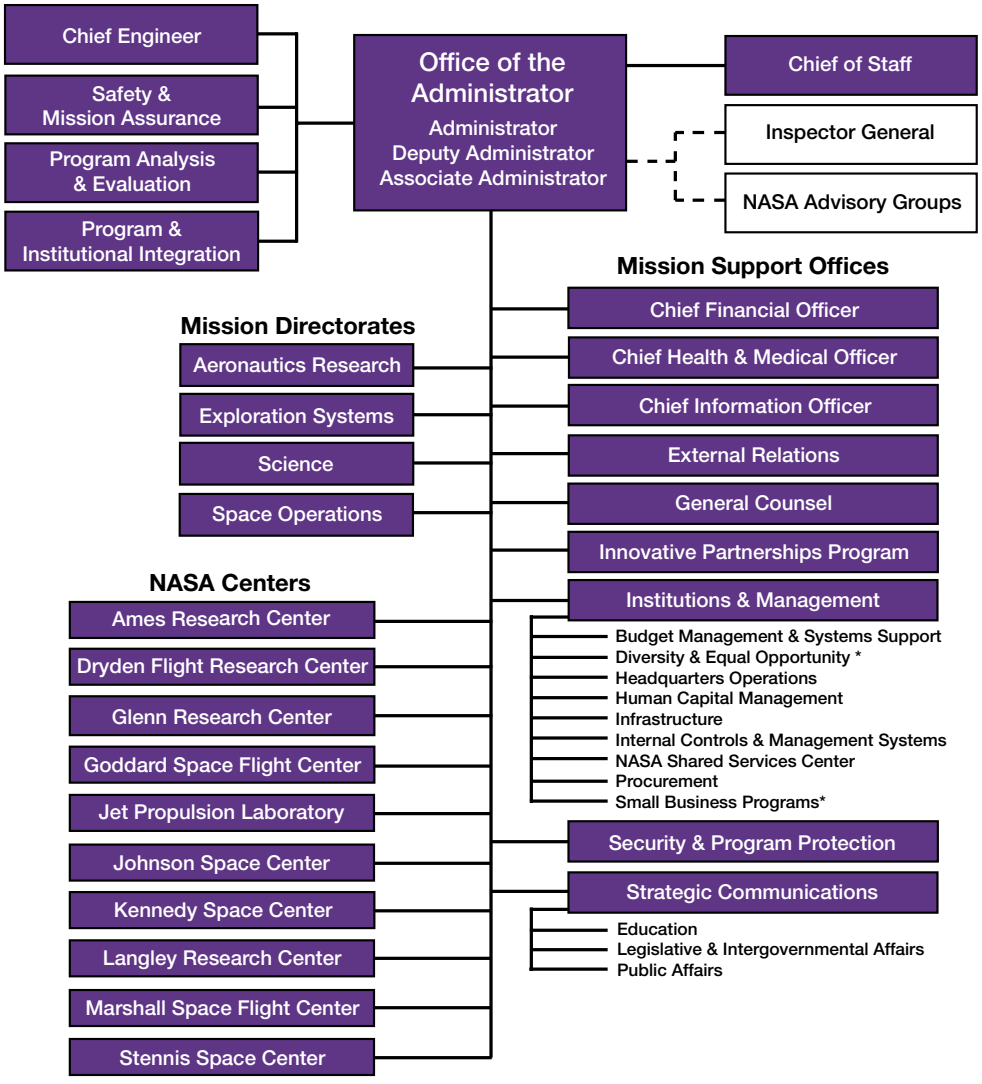
NASA's science, research, and technology development work is conceived of and implemented through its four Mission Directorates:

The **Aeronautics Research Mission Directorate (ARMD)** conducts fundamental research in aeronautical disciplines and develops capabilities, tools, and technologies that will significantly enhance aircraft performance, safety, and environmental compatibility, as well as increase the capacity and flexibility of the U.S. air transportation system.

The **Science Mission Directorate (SMD)** conducts the scientific exploration of Earth, the Sun, the solar system, and the universe. Missions include ground-, air-, and space-based observatories, deep-space automated spacecraft, and planetary orbiters, landers, and surface rovers. SMD also develops innovative science instruments and techniques in pursuit of NASA's science goals.

The **Exploration Systems Mission Directorate (ESMD)** develops the capabilities for long-duration human and robotic exploration. In support of the near-term goal of lunar exploration, ESMD is conducting robotic precursor missions, developing human transportation elements, creating innovative life support and medical technologies, and establishing international and commercial partnerships.

The **Space Operations Mission Directorate (SOMD)** directs spaceflight operations, space launches, and space communications and manages the operation of integrated systems in low Earth orbit and beyond, including the International Space Station (ISS). SOMD is laying the foundation for future missions to the Moon and Mars by using the ISS as an orbital outpost where astronauts can test systems and technology.



NASA organization as of September 30, 2009.

* In accordance with law or regulation, the offices of Diversity & Equal Opportunity and Small Business Programs maintain reporting relationships to the Administrator and Deputy Administrator.

White boxes indicate independent organizations that report to the Administrator.

NASA's Mission Support Offices ensure that critical support functions for facilities, resources (human, financial, material), and institutional systems are ready and available to maximize the success of the research, technology development, and operational missions. For more detailed information about the functions represented in the NASA organization go to *www.nasa.gov/about/org_index.html*.

NASA's Workforce

NASA employs over 18,000 civil servants at our nine Centers, Headquarters, and the NASA Shared Services Center, with an additional 5,000 people at the Jet Propulsion Laboratory. We have employees at facilities in 12 states and Washington, D.C. Having NASA employees spread out across the country means that much of the general U.S. public is close to a NASA Center or facility, and has the ability to develop a personal connection to NASA.

As we enter the second decade of the 21st century, there is a greater diversity of age in our workforce than ever before, with four generations working side by side in many of our organizations. Currently NASA is implementing new programs to pull more Generation Y workers, those with birth dates starting from the mid-1970s, into the NASA community as a way to strengthen our diversity and skill sets. New employees will be able to learn from expert employees, retaining valuable institutional knowledge that would otherwise be lost to future generations. The Office of Human Capital Management is implementing a new program called the Early-Career Hiring Initiative to increase the number of people hired for entry-level and early-career positions.

NASA remains one of the best places to work in the Federal government ranking third in the Partnership for Public Service's 2009 Best Places to Work survey of Federal agencies as identified by employees (see *data.bestplacestowork.org/bptw/index* for more information). We ranked particularly high in strategic management, teamwork, leadership, and support of diversity. This ranking is a 2.8 percent improvement over the last survey, conducted in 2007. We are proud to provide this level of employee satisfaction and are committed to improving our ranking in the future.

Shared Values, Shared Results

NASA has four shared core values that support our commitment to technical excellence and express the ethics that guide our behavior. Every NASA employee believes that mission success is the natural outcome of an uncompromising commitment to safety, technical excellence, teamwork, and integrity.

Safety: Constant attention to safety is the cornerstone upon which we build mission success. We are committed, individually and as a team, to protecting the safety and health of the public, NASA team members, and the assets that the Nation entrusts to the Agency.

Integrity: We are committed to maintaining an environment of trust, built upon honesty, ethical behavior, respect, and candor. Our leaders enable this environment by encouraging and rewarding a vigorous, open flow of communication on all issues, in all directions, and among all employees without fear of reprisal. Building trust through ethical conduct as individuals and as an organization is a necessary component of mission success.

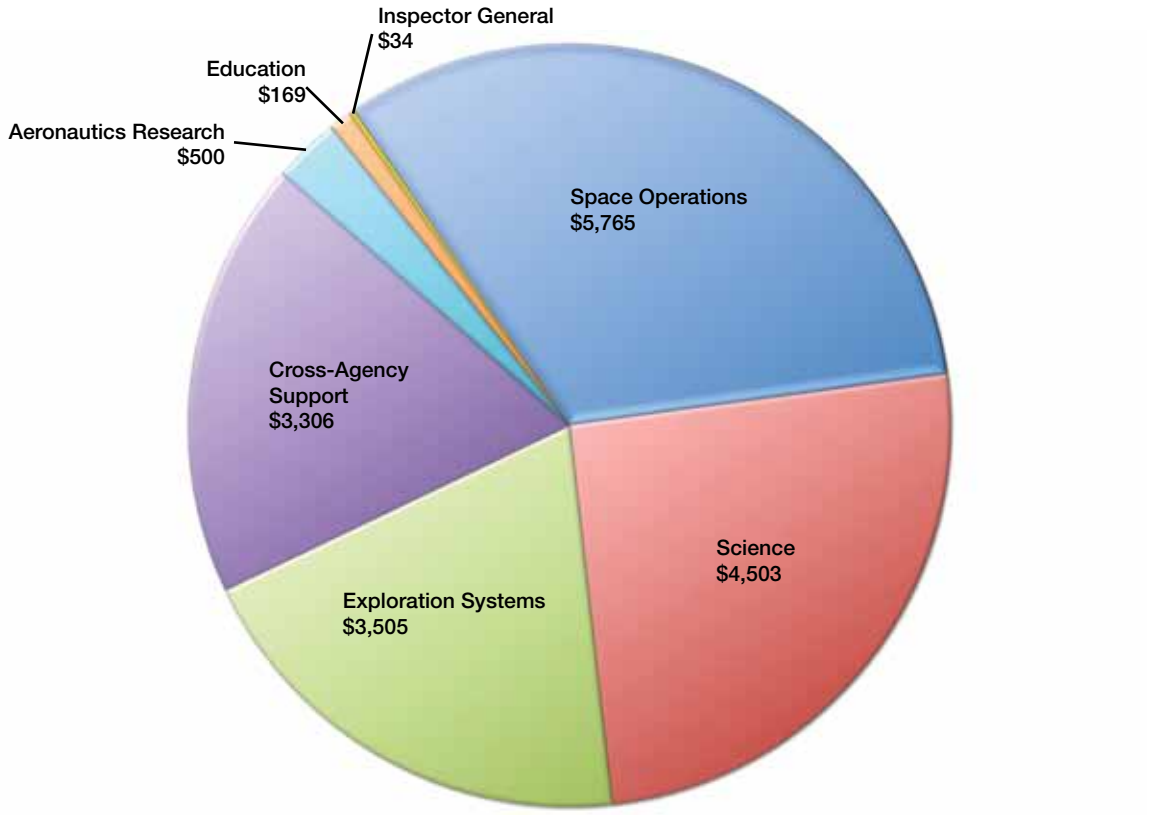
Teamwork: We strive to ensure that our workforce functions safely at the highest levels of physical and mental well-being. The most powerful tool for achieving mission success is a multi-disciplinary team of diverse, competent people across all NASA Centers. Our approach to teamwork is based on a philosophy that each team member brings unique experience and important expertise to project issues. Recognition of and openness to the insight of individual team members improves the likelihood of identifying and resolving challenges to safety and mission success. We are committed to creating an environment that fosters teamwork and processes that support equal opportunity, collaboration, continuous learning, and openness to innovation and new ideas.

Excellence: To achieve the highest standards in engineering, research, operations, and management in support of mission success, we are committed to nurturing an organizational culture in which individuals make full use of their time, talent, and opportunities to pursue excellence in both the ordinary and the extraordinary.

Budgeting for Performance: NASA's FY 2009 Budget

NASA's Fiscal Year (FY) 2009 budgetary resources totaled $17,782 million, an increase of about 2.2 percent from NASA's FY 2008 Budget. This increase demonstrates a commitment to funding the balanced priorities set forth for the Agency in space exploration, Earth and space science, and aeronautics research.

NASA's FY 2009 Enacted Budget Total: $17,782
(Dollars in Millions)



Note: Amounts do not include Recovery Act funds.

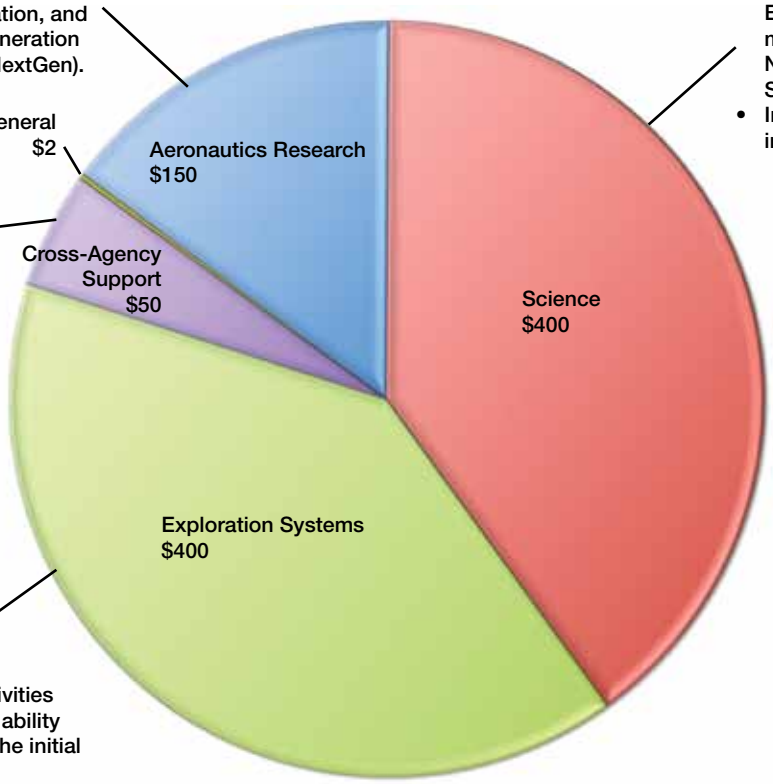
Proud to Serve the Nation: American Recovery and Reinvestment Act

The American Recovery and Reinvestment Act of 2009 (Recovery Act) was signed into law by President Obama on February 17, 2009. It is an unprecedented effort to jumpstart our economy, create and save millions of jobs, and modernize our Nation's infrastructure so our country can thrive in the 21st century.

We received $1,002 million in Recovery Act funds. Details on our progress are available at *www.nasa.gov/recovery/index.html*. From satellites that track and trend weather and natural hazards to creating a safer, more efficient air transportation system, our employees are proud to contribute to the breakthroughs and activities that will aid America's economic recovery.

NASA Recovery Act Funding Total: $1,002

(Dollars in Millions)



- Undertake systems-level research, development, and demonstration activities related to aviation safety, environmental impact mitigation, and development of the Next Generation Air Transportation system (NextGen).
- Accelerate the development of Earth Science climate research missions recommended by the National Academies' Decadal Survey.
- Increase NASA's supercomputing capabilities.
- Restore NASA-owned facilities damaged by hurricanes and other natural disasters that occurred in 2008.
- Fund critical mission activities that will improve NASA's ability to maintain the date for the initial operational capability.
- Stimulate efforts within the private sector to develop and demonstrate human spaceflight capability.

Performance Results

Managing and Measuring NASA's Performance

The Government Performance and Results Act of 1993 (GPRA) requires Federal agencies to issue plans for how they plan to spend budgeted resources and what they intend to achieve with this investment. This process starts with a strategic plan that sets the mission and outlines an agency's goals and objectives for at least five years. The agency's annual performance plan then describes the performance indicators and program outputs needed to achieve the goals and objectives.

NASA's 2006 Strategic Plan[2] established six Strategic Goals, with six Sub-goals under Strategic Goal 3.

Strategic Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Strategic Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human spaceflight program to focus on exploration.

Strategic Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Strategic Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Strategic Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

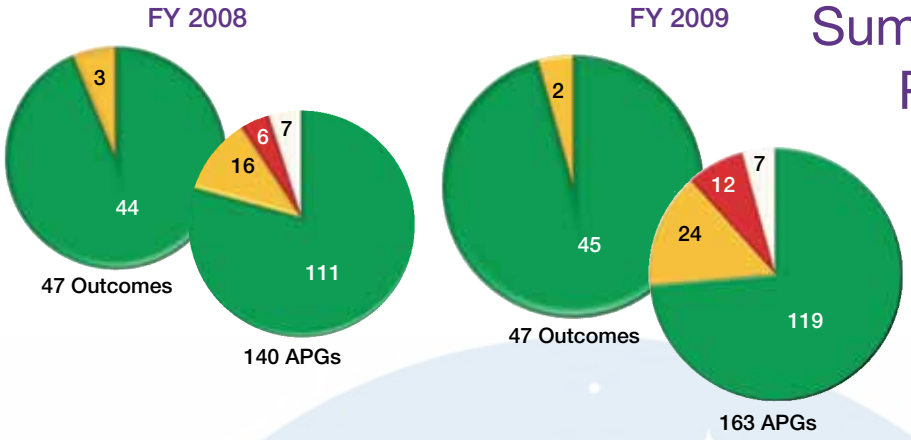
Each of the six Strategic Goals is clearly defined and supported by multi-year Outcomes that enhance our ability to measure and report our accomplishments. We also set Annual Performance Goals (APGs) that demonstrate progress for achieving our Outcomes. The APGs are updated annually as part of NASA's Performance Plan[3] and are included in NASA's annual Budget Estimates.

Progress toward achieving NASA's Outcomes and APGs is measured and communicated via color ratings (red, green, yellow, and white). NASA managers in the Mission Directorates and Mission Support Offices determine ratings for the multi-year Outcomes and APGs based on a series of internal and external assessments that are part of ongoing monitoring requirements in NASA's Performance Management System.

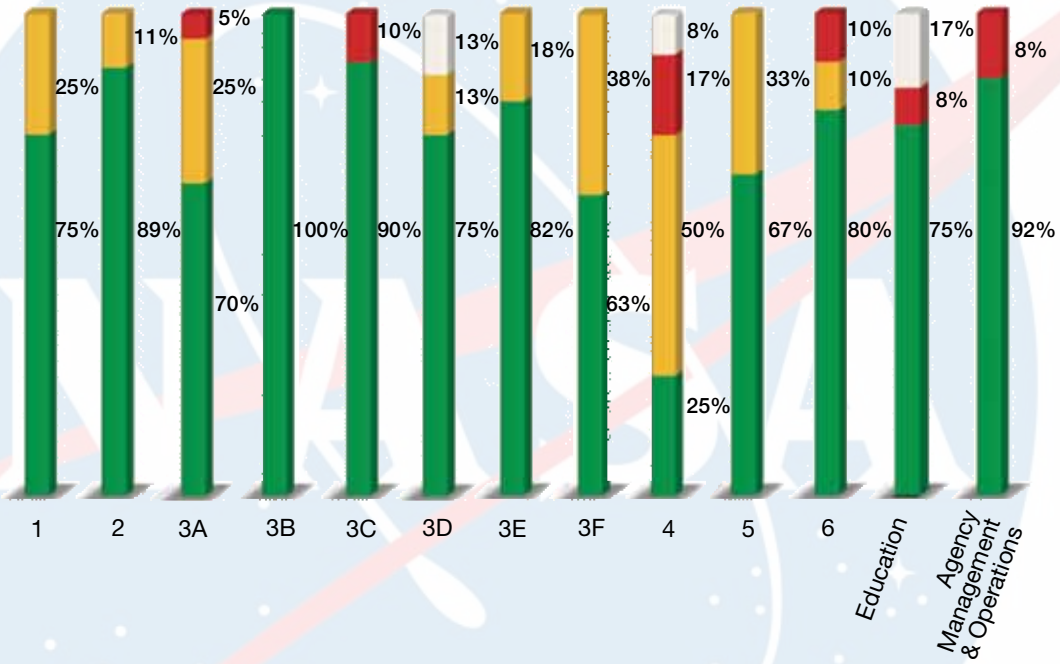
What do the color ratings mean?		
Color	**Multi-year Outcome Rating**	**Annual Performance Goal Rating**
Green	NASA achieved most APGs under this Outcome and is on-track to achieve or exceed this Outcome.	NASA achieved this APG.
Yellow	NASA made significant progress toward this Outcome, however, the Agency may not achieve this Outcome as stated.	NASA failed to achieve this APG, but made significant progress and anticipates achieving it during the next fiscal year.
Red	NASA failed to achieve most of the APGs under this Outcome and does not expect to achieve this Outcome as stated.	NASA failed to achieve this APG and does not anticipate completing it within the next fiscal year.
White	This Outcome was canceled by management directive or is no longer applicable based on management changes to the APGs.	This APG was canceled by management directive and NASA is no longer pursuing activities relevant to this APG, or the program did not have activities relevant to the APG during the fiscal year.

[3]NASA's 2006 Strategic Plan can be found at *www.nasa.gov/pdf/142303main_2006_NASA_Strategic_Plan_sm.pdf*.
[4]NASA's FY 2009 Performance Plan can be found at *www.nasa.gov/pdf/344569main_FY09_section_of_MPP.pdf*.

Summary of NASA's Performance



FY 2009 APG Ratings by Strategic Goal or Equivalent



FY 2009 Cost by Strategic Goal

(Dollars in Millions)

Total cost is $22,467.

Amounts in the chart may not agree with the total, as per the Statement of Net Cost, or totals in *Detailed Performance* due to rounding.

Managers rely on feedback from advisory groups and experts in the field to guide their rating decisions. Advisory groups such as the NASA Advisory Council, the National Academies, and the Aerospace Safety Advisory Panel, assess program content and direction. Experts from the science community also review our progress toward meeting the performance measures under Sub-goals 3A through 3D, and, managers assign ratings to the science-related Outcomes and APGs based on these experts' findings. The previous page shows a breakdown of the FY 2009 performance results by percentages of Green, Yellow, Red, and White ratings for the Outcomes and APGs.

Our performance data provides a foundation for both programmatic and institutional decision-making processes and supports decisions concerning strategy and budget. Internally, we monitor and analyze how each program manages its budget and schedule. These analyses are provided during quarterly and monthly reviews at the Center, Mission Directorate, and Agency levels to communicate the health and performance of a program. The final performance results reflected in this report will inform our planning for the upcoming Strategic Plan (due to be released in early 2010) and the FY 2011 budget request.

FY 2009 Cost Toward Strategic Goals

To measure cost toward Strategic Goals and Sub-goals, NASA maps the Mission Directorate's costs (i.e., Lines of Business as presented in the Statement of Net Cost) to the Strategic Goals and Sub-goals via Themes and programs. In 2003, we created Themes as a bridge to connect related Agency programs and projects to the Mission Directorates or equivalents that manage the programs. Themes group together similar programs, such as the programs that conduct Earth science or support the Agency's spaceflight missions, into budgeting categories. NASA uses Themes and programs to track performance areas, with Themes often contributing to a single Strategic Goal or Sub-goal, with a few exceptions.

NASA analyzes the fiscal year Operating Plan to determine the portion of each Mission Directorate budget allocated to each Theme and/or program, thus tying it to a particular Strategic Goal or Sub-goal. Our analysts then use NASA's financial statements, in particular the Statement of Net Cost, to allocate Line of Business cost to the Themes and then Strategic Goals and Sub-Goals based on the relationships determined in the Operating Plan, as displayed in the previous page.

Performance Highlights

The following section highlights NASA's significant achievements and efforts under each Strategic Goal in FY 2009. For complete ratings and narratives describing NASA's progress toward achieving our APGs, multi-year Outcomes and Strategic Goals, please see the *Detailed Performance* section. For more information on NASA's missions, please see the NASA's Missions at a Glance located in the *Other Accompanying Information* section of this document.

Goal 1: Fly the Shuttle as safely as possible until its retirement, not later than 2010.

Responsible Mission Directorate: Space Operations

The Space Shuttle Program flew five successful Shuttle missions in FY 2009, increasing the crew size on the International Space Station (ISS) and refurbishing the Hubble Space Telescope. In March, the Space Transportation System (STS)-119 mission delivered the final set of ISS solar arrays, the last major ISS structure needed to accommodate a six-person crew.

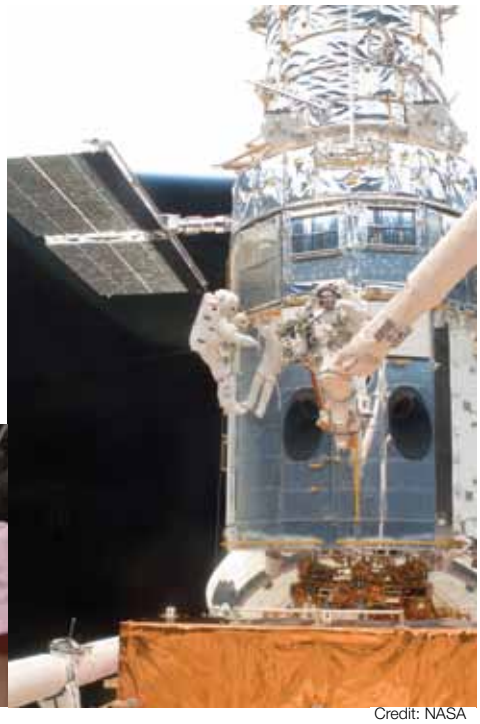
The first six-person ISS crew flew in May, which combined with the seven crewmembers who flew to the ISS on STS-127 in July, allowed NASA and the International Partners to set a record for the largest group of people ever to live and work in space at one time. A full six-person crew gives the U.S. and our International Partners the ability to use the ISS for science and operations, and means that all partner nations have a greater chance to fly their astronauts to the ISS.

Also in May, STS-125 completed the last Hubble Space Telescope servicing mission, upgrading and refurbishing the 19 year-old telescope. The crew conducted five spacewalks, each lasting between seven and eight hours, on five consecutive days, often using real-time fixes to complete complex tasks. The crew installed the new Wide Field Camera 3, which allows Hubble to take large-scale, extremely clear and detailed pictures at ultraviolet and infrared wavelengths, a dramatic improvement over all previous Hubble cameras. They installed the Cosmic Origins

John Grunsfeld (above) faces a reflection of himself in the shiny, mirror-like surface of the Hubble Space Telescope, while Andrew Feustel approaches on the end of the remote manipulator system arm. The telescope is temporarily captured by Atlantis so that the astronauts can safely perform their work. The two mission specialists are performing the first of five STS-125 spacewalks. Mission specialists Megan McArthur and Mike Massimino (inset) work controls, such as the controls for the remote manipulator system arm, on the aft flight deck during flight day three activities. President Barack Obama (inset) talks to the crew before they go to sleep on flight day 10, the day after they released the freshly serviced telescope. "Like a lot of Americans, I've been watching with amazement the gorgeous images you've been sending back, and the incredible repair mission you've been making in space," the President said. "I think you're providing a wonderful example of the kind of dedication and commitment to exploration that represents America and the space program generally. These are traits that have always made this country strong, and all of you personify them."

Credit: NASA /White House/P. Souza

Credit: NASA



Credit: NASA

Spectrograph, which can observe faint, far-away light sources that provide clues to the evolution of galaxies and the origin of stellar and planetary systems. The STS-125 crew also performed a tune-up, replacing old gyroscopes, batteries, and a fine guidance sensor, which locks onto stars as part of the pointing system.

In addition to the Hubble servicing mission and setting a world space record, the four Shuttle flights to the ISS delivered the final international laboratory module (a series of Japanese elements), the last of four solar power arrays (each as long as the width of a football field), and several tons of hardware, supplies, and research equipment. For more about recent and upcoming Space Shuttle missions, go to *www.nasa.gov/topics/shuttle_station/index.html*.

Goal 2: Complete the International Space Station in a manner consistent with NASA's International Partner commitments and the needs of human exploration.

Responsible Mission Directorate: Space Operations

On December 4, 1998, Space Shuttle Endeavour (STS-88) lit the night sky as it launched toward an historic moment: the first construction mission for the ISS, attaching the U.S. Unity node to the Russian Zarya module already in orbit. Once the two parts were joined, Commander Robert Cabana and Cosmonaut Sergei Krikalyov were the first people to enter the new outpost in low Earth orbit. NASA and our International Partners celebrated 10 years of success with a busy year of work towards completing the ISS. In November 2008, the STS-126 mission delivered the equipment necessary to double the crew size of the ISS, including a galley, crew quarters, a waste and hygiene compartment, and a water recovery system that recycles urine into clean, clear drinking and coolant water. This capability is critical for weaning the ISS from dependence on the Space Shuttle for water resupply, preparing it for the Shuttle fleet's planned retirement in 2010 while also testing a critical technology for future space exploration. With the addition of the final set of solar arrays, delivered by the STS-119 crew in March, the ISS was ready to accommodate its first six-person crew at the end of May. The STS-119 mission also delivered astronaut Koichi Wakata, the Japan Aerospace Exploration Agency's (JAXA's) first ISS crewmember. In July, the STS-127 mission delivered the final

Credit: NASA

November 18, 2008, Astronauts perform a spacewalk to clean and lubricate part of the ISS's starboard Solar Alpha Rotary Joints (SARJ) and to remove two of SARJ's 12 trundle-bearing assemblies.

piece of JAXA's Kibo laboratory, the Japanese Experiment Module–Exposed Facility, a permanent "porch" that allows experiments to be exposed to the space environment.

An important part of achieving Strategic Goal 2 is turning the ISS into an effective on-orbit research laboratory for testing technologies and capabilities for space exploration and Earth applications. As part of the International Partner commitments, the crew share facilities and help each other on research projects, making the most of available resources as the outpost approaches full operations. The STS-126 mission delivered the Multi-user Droplet Combustion Apparatus, a modular insert for the Combustion Integrated Rack that holds fire suppression and flame extinguishment experiments. The first experiment conducted in the new apparatus, the Flame Extinguishment Experiment, tested the performance of fire suppressants in space with the goal of selecting fire suppressants for the next generation of space capsules, like Orion. The Smoke Point in Coflow Experiment studied the point at which gas jet flames begin to emit soot, important for soot control in combustors ranging from jet engines to coal-burning power plants.

Credit: NASA

ESA astronaut Frank De Winne, Expedition 20 flight engineer, works with the InSPACE-2 investigation in the ESA-built Microgravity Science Glovebox—an enclosed research facility for working with messy or potentially hazardous materials. The investigation is studying suspensions of paramagnetic particles that can quickly solidify when exposed to a magnetic field and return to their original liquid state when the magnetic field is removed. This unique behavior could be used to improve or develop new brake systems or robotics.

The Crew also participated in the Integrated Cardiovascular investigation to determine how much the heart muscle decreases in size while crew are on the ISS and how effective their current exercise program is at protecting their heart strength. Three International Partner agencies—NASA, the European Space Agency (ESA), and the Canadian Space Agency—are working together on the investigation. More information on the many ISS experiments conducted during each Expedition can be found at *www.nasa.gov/mission_pages/station/main/index.html*.

Goal 3A: Study Earth from space to advance scientific understanding and meet societal needs.

Responsible Mission Directorate: Science

On September 26, 2009, tropical storm Ketsana hit the Philippines, causing record flooding in the capital, Manila, on the island of Luzon and killing over 200 people. After passing through the Philippines, Ketsana intensified into a typhoon over the central South China Sea and made landfall near Da Nang along the central coast of Vietnam. NASA's suite of Earth observing satellites are providing NASA scientists and users around the world with many vital measurements to capture weather events like Ketsana to increase our understanding of the Earth's climate, improve weather forecasting, and assist disaster mitigation efforts.

Over the past year, a team of researchers published in the *Journal of the Meteorological Society of Japan* (volume 87A, 2009) a new climatology of tropical surface rain based on 10 years of precipitation retrievals and analyses from the TRMM satellite, a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA). TRMM is designed to help our understanding of the water cycle in the current climate system. By covering the tropical and semi-tropical regions of Earth, TRMM provides much-needed data on rainfall and the heat release associated with rainfall. Responsible for three quarters of the energy that drives the global atmospheric circulation, tropical rainfall can be said to drive Earth's "Climate Machine."

Using TRMM data NASA scientists (Lau et al., *Journal of Geophysical Research*, 2008) have found in recent decades (1979 through 2005) a positive trend in heavy to very-heavy rainfall in the tropical Atlantic during the July through November season. They also found that tropical cyclones are

Credit: NASA/MODIS Rapid Response Team

The MODIS instrument on NASA's Terra satellite captured this view of Ketsana on the morning of September 28, 2009, local time, as it approached Vietnam. It made landfall the next day.

increasingly more energetic and have contributed to increased extreme heavy rainfall events, due to both accumulated longer storm duration and heavier rain per storm day. These results are consistent with previous studies regarding the more frequent occurrence of extreme rain events in recent decades, and offer new scientific insights into the possible linkage between hurricane intensity and global warming.

Working with partners at the National Oceanic and Atmospheric Administration (NOAA) weather forecast offices, measurements from the NASA Atmospheric Infrared Sounder (AIRS), the Lightning Mapping Array (LMA), and the Moderate Resolution Imaging Spectroradiometer (MODIS) instruments continue to improve the skills of operational weather forecasts. Goddard Space Flight Center scientists recently implemented a new assimilation modeling scheme of AIRS temperature retrievals and demonstrated significant improvement in the "hindcasting" of cyclone Nargis, which killed around 100,000 people in Myanmar in May 2008 (Reale et al., 2009, *Geophysical Research Letters* 36). Researchers use retrospective analysis, or hindcasting, to plot the precise course of storms that have already happened. Hindcasting helps researchers reveal trends that can improve forecasting. By directly assimilating cloud-cleared temperature profiles instead of radiances typically rejected by the numerical prediction models in cloud scenes, the displacement error in the five day forecast was less than 31 miles of the actual landfall, as opposed to approximately 125 miles in the typical forecast. The improvement came from retrieval information in the presence of clouds, while radiance assimilation schemes stringently reject all cloudy scenes. The improvement came from retrieval information in the presence of clouds, while radiance assimilation schemes stringently reject all cloudy scenes.

Goal 3B: Understand the Sun and its effects on Earth and the solar system.

Responsible Mission Directorate: Science

Even though Earth is 93 million miles away from the Sun, our planet is affected by what happens on the Sun's surface. Sunspots are planet-sized islands of magnetism on the surface of the Sun and are the sources of solar flares and coronal mass ejections that produce streams of high-energy particles and radiation. These outbursts can harm life, alter its evolution, and disrupt many processes on Earth including satellite communications and global positioning system applications. For astronauts working in space, sunspot activity can pose a greater radiation risk and compromise spacecraft systems.

Sunspots typically occur in an 11-year cycle with minimal sunspot activity—or solar minimum—occurring at one end of the cycle and more intense sunspot activity—or solar maximum—occurring at the other end. At their most extreme, the solar minimum and solar maximum can affect weather patterns. For example, scientists think that an extended solar minimum may have contributed to a period from 1645 to 1715, often referred to as the Little Ice Age, of harsh winters, torrential rains, and crop failures across the Northern Hemisphere.

We are currently in an extended solar minimum and 2009 has been the quietest year on the Sun since 1913. A number of NASA missions—SOHO, AIM, the CINDI instrument aboard the U.S. Air Force's C/NOFS spacecraft, the five THEMIS probes, the twin STEREO imagers, TRACE, and others—have been observing different aspects of this solar minimum. In 2008, there were 266 spotless days, and up through September 30, there were 215 days without sunspots for 2009.

Measurements by the Ulysses spacecraft show that solar wind pressure has dropped 20 percent since the mid-1990s. The solar wind helps keep galactic cosmic rays out of the inner solar system. With the solar wind flagging, more cosmic rays reach Earth, resulting in increased health hazards for astronauts. Weaker solar wind also means fewer geomagnetic storms and auroras, the beautiful northern and southern (polar) lights we see on

This composite image, taken on August 7, 2009, is made by combining two images taken 12 hours apart by the STEREO spacecraft to provide a three-dimensional extreme ultraviolet image of the quiet Sun. In those 12 hours, the Sun has rotated around enough to create a sufficiently separated perspective to create 3D. The Sun in extreme ultraviolet light shows us a dark coronal hole near the central line and northern pole from which fast solar wind is streaming. We also can see loops of magnetic field lines arcing out and above a small active region to the lower right. Images in ultraviolet light reveal the detailed structure of the deep solar atmosphere as compared to visible light that looks at the near featureless surface of the Sun (photosphere). These image colors are suitable for right eye/left eye 3D anaglyph viewing.


Credit: NASA

Earth. Measurements by other NASA spacecraft show that the Sun's brightness has dimmed 0.02 percent at visible wavelengths and six percent at extreme ultraviolet wavelengths since the solar minimum of 1996. One effect of this change is that the upper atmosphere is less heated and not as "puffed up," which means that satellites in low Earth orbit experience less atmospheric drag, extending their operational lifetimes.

All of the observations by NASA spacecraft suggest that the upcoming solar cycle may be significantly different than previously observed cycles. Understanding our Sun's connection to Earth as an integrated system is essential to protecting technologies on Earth from space weather effects and enhances the productivity and safety of space explorers.

Goal 3C: Advance scientific knowledge of the origin and history of the solar system, the potential for life elsewhere, and the hazards and resources present as humans explore space.

Responsible Mission Directorate: Science

Scientists are trying to solve the mystery of one of the most recognizable features in the solar system—Saturn's rings. We do not know if Saturn's rings formed back in the early stages of the solar system (about four billion years ago) or formed as recently as when dinosaurs roamed on Earth (about 65 million years ago). Regardless of when they first formed, we do know that the rings we observe today were not all created in exactly the same way. Understanding how these beautiful rings formed will give us insight into how the outer solar system evolved. Thanks to an event that occurred this year, NASA has gathered a treasure trove of data that may solve some of Saturn's mysteries.

Saturn orbits the Sun every 30 years. Twice during Saturn's orbital trip—or every 15 years—sunlight hits Saturn's rings exactly edge-on, making them all but disappear. On August 11, 2009, Saturn's equinox revealed bumps as high as the Rocky Mountains in Saturn's rings. Previously, scientists thought these bumps were about the size of a two-story building; instead, one ridge of icy ring particles, whipped up by the gravitational pull of Saturn's moon Daphnis as it travels through the plane of the rings, looms as high as 2.5 miles. It is the tallest vertical wall seen within the rings.

At the same time the Cassini spacecraft snapped visible-light photographs of Saturn's rings, its Composite Infrared Spectrometer instrument was taking the rings' temperatures. During the equinox, the rings cooled to the lowest temperature ever recorded. The A ring dropped down to a frosty 382 degrees below zero Fahrenheit. Studying ring temperatures at equinox will help scientists better understand the sizes and other characteristics of the ring particles.

Credit: NASA/JPL/Space Science Institute

This view, taken by the Cassini spacecraft in a series of 15 images, is only possible around the time of Saturn's equinox, which occurs every half-Saturn-year. The equinox lowers the Sun's angle to the ring plane, significantly darkens the rings, and causes out-of-plane structures to cast long shadows across the rings. Cassini's cameras have spotted not only the predictable shadows of some of Saturn's moons, but also the shadows of newly revealed vertical structures in the rings themselves. The gentle, spiraling undulation discovered in 2006 extending across the D ring is now seen, under better viewing conditions, to extend fully across the C ring, right up to the inner B ring. In 2006, imaging scientists speculated that a collision with a comet or asteroid may have disturbed the D ring. That explanation seems less likely now that this and other new images show the effect spread over a much broader radial range, covering a radial distance of about 11,000 miles. The enormous extent of the corrugation now makes its existence more mysterious than ever, and imaging scientists are struggling to understand its origin. Further outward, a bending wave, created by a resonance with the moon Iapetus, can be easily seen just beyond the Cassini Division, leading into the inner A ring. The shadow of the moon Dione is seen in several locations on the rings because of the shadow's motion across the rings during the time the mosaic images were being acquired.

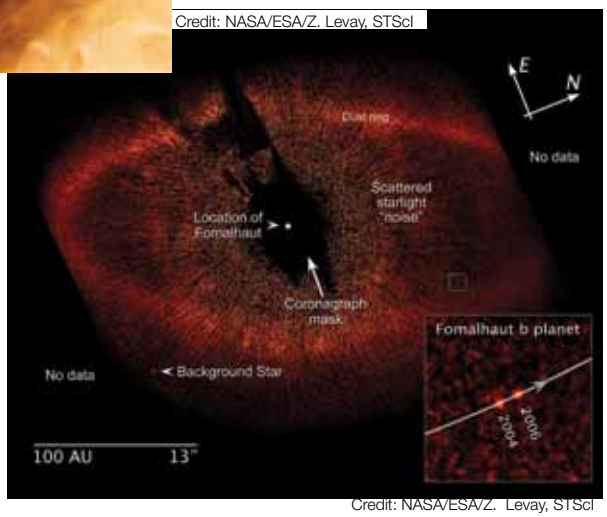
Scientists also were intrigued by bright streaks in two different rings that appear to be clouds of dust kicked up in collisions between small space debris and ring particles, which were easier to see under the low-lighting conditions of equinox. Understanding the rate and locations of impacts will help them build better models of contamination and erosion in the rings and refine estimates of their age.

Goal 3D: Discover the origin, structure, evolution, and destiny of the universe, and search for Earth-like planets.

Responsible Mission Directorate: Science

Astronomers have taken a direct image of an extra solar planet with the Hubble Space Telescope. The planet circles the bright southern star Fomalhaut, located in the constellation Piscis Australis. The astronomers estimate that the planet, called Fomalhaut b, is no more than three times Jupiter's mass, which is enormous compared to Earth but a proverbial needle in a haystack for planet hunters, considering it is located 25 light-years away. Since the Fomalhaut system is only 200 million years old—extremely young by planetary standards—images like this help astronomers study how planets and planetary systems evolve around stars, an important step toward achieving Sub-goal 3D.

Credit: NASA/ESA/Z. Levay, STScI



Credit: NASA/ESA/Z. Levay, STScI

The small white box at lower right pinpoints the location of planet Fomalhaut b, which has carved a path along the inner edge of a vast, dusty debris ring encircling its parent star, Fomalhaut. The inset at bottom right is a composite image showing the planet's position during Hubble observations taken in 2004 and 2006. Astronomers have calculated that Fomalhaut b completes an orbit around its parent star every 872 years. The white dot in the center of the image marks the star's location. The black region around the star is where the Advanced Camera's coronagraph has blocked out glare. The inset artist's view shows how the planet might look in its neighborhood of dusty debris.

Fomalhaut has been a candidate for planet hunting ever since an excess of dust was discovered around the star in the early 1980s by NASA's Infrared Astronomy Satellite (IRAS). Then in 2004, the coronagraph (which blocks out a star's bright glare so that nearby objects can be resolved) in the High Resolution Camera on Hubble's Advanced Camera for Surveys produced the first-ever resolved visible-light image of a large dust belt surrounding the star. It clearly showed that the dust belt has a ring of protoplanetary debris, similar to the Kuiper Belt encircling our solar system, which could evolve into a planetary system.

Hubble astronomers proposed in 2005 that the ring was being gravitationally modified by a planet lying between the star and the ring's inner edge. Evidence came from Hubble's confirmation that the ring is offset from the center of the star. The sharp inner edge of the ring is also consistent with the presence of a planet that gravitationally "shepherds" ring particles. Independent researchers have subsequently reached similar conclusions. Now, Hubble has actually photographed a point source of light lying 1.8 billion miles inside the ring's inner edge.

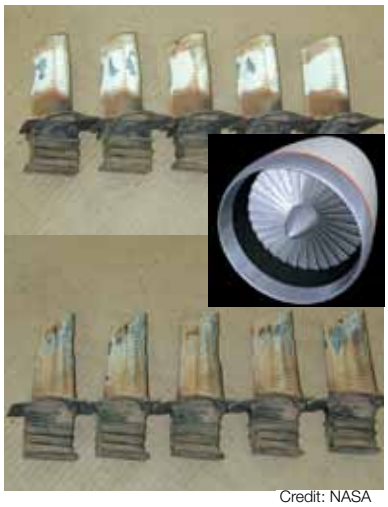
Future observations will attempt to see Fomalhaut b in the near- and mid-infrared, giving scientists more clues about characteristics of the planet and its potential to support life. For more about our Astrophysics programs, go to *www.nasa.gov/topics/universe/index.html*.

Goal 3E: Advance knowledge in the fundamental disciplines of aeronautics, and develop technologies for safer aircraft and higher capacity airspace systems.

Responsible Mission Directorate: Aeronautics Research

Keeping aviation accidents rare, as commercial air transport of passengers and cargo grows, demands improvements in the intrinsic safety of current and future aircraft. Therefore, NASA researchers have developed an innovative method for the on board estimation of aircraft jet engine health and performance to help avoid engine failures and more accurately identify the need for engine maintenance.

NASA researchers have developed an innovative method for the on-board estimation of aircraft engine performance parameters that can be used by aircraft engine controls and health management applications to help avoid engine failure, improve aircraft safety, and move us toward achieving Sub-goal 3E.



Credit: NASA

Years of wear are shown on aircraft turbofan engine blades in these photos. An integral part of the fan, visible at the center of the illustration, the blades propel a continuous airstream into the engine's combustion chamber. If the blades become overly degraded, due to age or ingestion of debris during flight, they can hamper engine performance or cause engine failure. NASA's Integrated Vehicle Health Management project has developed an improved method to estimate aircraft engine health parameters and engine performance degradation.

Engine components wear over time, affecting an aircraft engine's performance. The level of engine degradation is described in terms of immeasurable health parameters like the efficiency or flow capacity of each major engine component. Using mathematical techniques, researchers can estimate the health parameters and level of engine performance degradation. To do this with enough accuracy, the researchers must place sensors throughout the engine equal to or greater than the number of parameters they need to estimate. However, the number of sensors available throughout an engine is typically less than required.

A common approach to address this shortcoming is to estimate a sub-set of the health parameters, though this can introduce significant error in the estimation of overall engine health and performance. Therefore, our Integrated Vehicle Health Management project has developed an innovative method that enables estimation of all health parameters such that the overall engine health and performance estimation error is minimized. Project researchers have validated the new methodology in simulations using an aircraft turbofan engine model. The results agreed with theoretical predictions and demonstrated that applying the enhanced technique resulted in a 31.6 percent reduction in average estimation error compared to a conventional approach.

For more about our Aeronautics programs, go to *www.nasa.gov/topics/aeronautics/index.html*.

Goal 3F: Understand the effects of the space environment on human performance, and test new technologies and countermeasures for long-duration human space exploration.

Responsible Mission Directorates: Exploration Systems and Space Operations

Keeping astronauts healthy and productive in space goes beyond medicine and exercise. It includes technologies that protect crewmembers while remaining practical and comfortable to use. In October, NASA tested the pickup truck-sized pressurized Lunar Electric Rover, a transport and mini-habitat for two crewmembers in the Arizona desert.

Until recently, NASA operated the vehicle chassis as an unpressurized rover that required crewmembers to be suited. By adding a pressurized module on top, the crewmembers can shed the cumbersome spacesuits and steer from inside the mobile habitat. The spacesuits attach to the outside of the rover and the crewmembers transfer via a suit-port interface. The pressurized rover, which can serve as a roaming home for two people, has separate sleeping areas, sanitary facilities, and a modular design that allows various tools like bulldozer blades to be added for special

Credit: NASA

For the October 2008 test, called Desert RATS, engineers, geologists, and astronauts came together at Black Point Lava Flow in Arizona to test our new Lunar Electric Rover. Using a spacesuit alone, an astronaut only has about eight hours to explore and conduct research before having to return to a central base. In the rover, two crewmembers can drive for days or weeks, suiting up only when they need to get a closer look or gather a sample. Tests like this help us work out glitches in a safe, analog environment and gather lessons learned. For example, the team learned that they could change a flat tire while wearing spacesuits.

missions. The rover also features pivoting wheels and active suspension that allows it to raise and lower as necessary to go over obstacles and get close to interesting geological features. Then crewmembers can climb through the suit-port into their spacesuits and begin exploring the area with considerable speed and ease.

Astronaut Mike Gernhardt and planetary geologist Pascal Lee tested the rover and were both impressed. Gernhardt reported that the habitat never felt cramped or confined; an important feature for longer missions. The test also showed that the rover could be used for lunar geological surveys. "For a geologist thinking about the best way to explore the Moon or Mars, it is a dream come true," Lee said. "I really think NASA is on the right track with this concept."

For more on our research to keep astronauts healthy and productive, go to *humanresearch.jsc.nasa.gov* and *www.nasa.gov/exploration/analogs/index.html*.

Credit: NASA

With a flash of fire and a large cloud of smoke, the DM-1 successfully passes its first full-scale, full-duration test firing at ATK Space Systems' test stand in Utah. The motor will provide the backbone for the Ares I, generating up to 3.6 million pounds of thrust, or lifting power, at launch. The DM-1 is managed by the Ares Projects at NASA's Marshall Space Flight Center. Another ground test is planned for summer 2010.

Goal 4: Bring a new Crew Exploration Vehicle into service as soon as possible after Shuttle retirement.

Responsible Mission Directorate: Exploration Systems

NASA's Constellation Program completed several milestones this fiscal year. For example, the Orion project completed several major tests and its Preliminary Design Review, allowing the program to move closer to achieving Strategic Goal 4.

On September 10, 2009, NASA and industry engineers lit up the Utah sky with the initial full-scale, full-duration test firing of the first stage motor for the Ares I rocket. ATK Space Systems, the prime contractor for the Ares I first stage, conducted the successful stationary firing of the five-segment solid Development Motor 1, or DM-1. Engineers will use the measurements gathered from the test to evaluate thrust, roll control, acoustics, and motor vibrations to help refine existing models that will be used to inform the design of future launch vehicles. Although similar to the solid rocket boosters that help power the Space Shuttle to orbit, the Ares development motor includes several upgrades and technology improvements.

The Ares I-X flight test is positioned to achieve its demonstration objectives in early FY 2010. From the development and deployment of the lighting protection system to the deployment of the program is positioned to conduct the test flight at the beginning of FY 2010.

For more about Constellation, go to *www.nasa.gov/mission_pages/constellation/main/index.html*.

Goal 5: Encourage the pursuit of appropriate partnerships with the emerging commercial space sector.

Responsible Mission Directorates: Exploration Systems and Space Operations

NASA's Commercial Crew and Cargo Program seeks to stimulate development of safe, reliable, and cost-effective space transportation capabilities within the emerging commercial space sector. The goal is to obtain crew and cargo launch options for our missions, a key part of achieving Strategic Goal 5, while encouraging growth and competition in the U.S. space industry. As part of the program, the Commercial

Credit: SpaceX

SpaceX's Falcon 9 launch vehicle sits on the pad at Cape Canaveral, Florida. The SpaceX team completed vehicle integration, preparing it for a test launch, on December 30, 2008. The COTS UHF CUCU radio transceiver, shown in the left photo, sits inside an electromagnetic interference test chamber.

Credit: SpaceX

Orbital Transportation Services (COTS) has funded Space Act Agreements with two partners, Space Exploration Technologies (SpaceX) and Orbital Sciences Corporation (Orbital).

Under the Cargo Resupply services contract, in December 2008, we awarded contracts to resupply the ISS utilizing newly developed vehicles capable of launching a spacecraft and cargo into low Earth orbit, and/or a spacecraft that can carry unpressurized or pressurized cargo and robotically dock with the ISS. Each contractor will provide a slightly different capability: The SpaceX vehicle will deliver pressurized cargo to the ISS and return pressurized cargo to Earth, while the Orbital vehicle will deliver pressurized cargo to the ISS and provide disposal capability, similar to the Russian Progress vehicles.

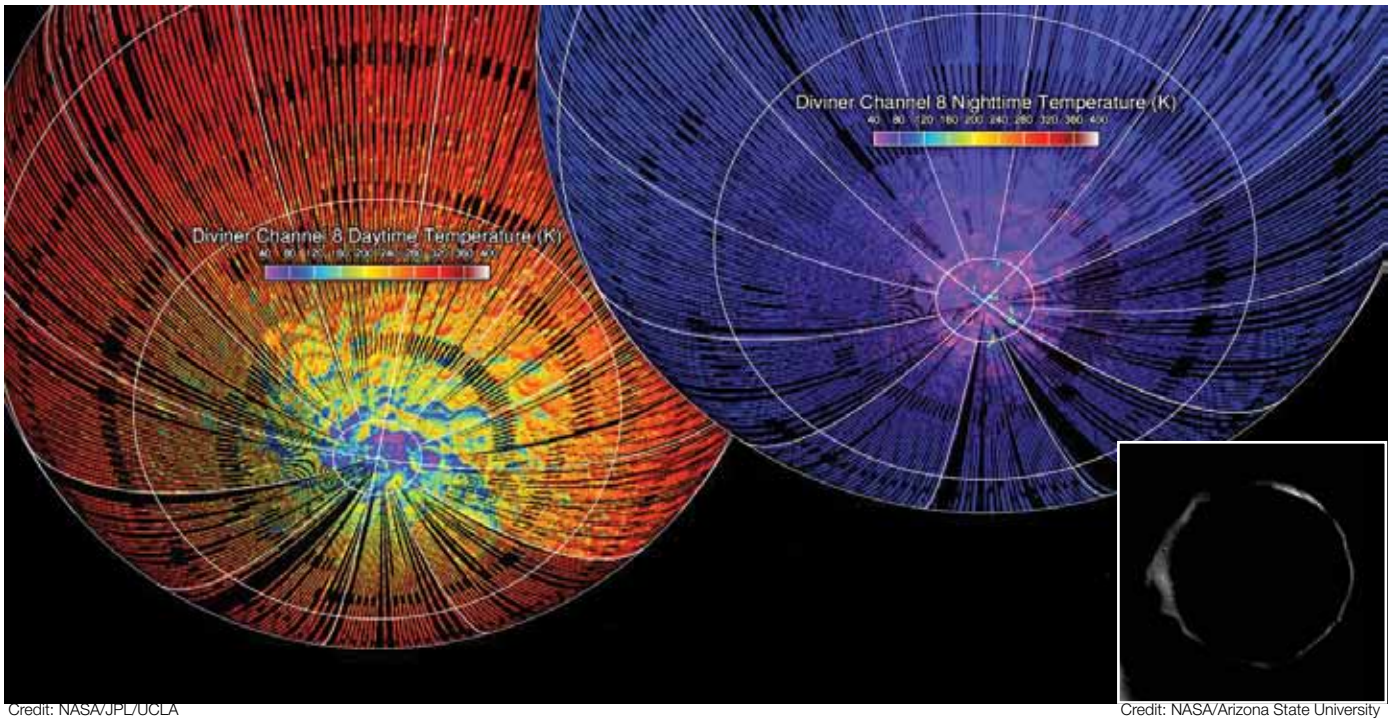
In preparation for their service to the ISS, SpaceX delivered the COTS Ultra High Frequency (UHF) Communication Unit (CUCU) to the Kennedy Space Center for launch on Atlantis STS-129 mission, scheduled for no earlier than November 16, 2009. ISS and Shuttle crewmembers will integrate the hardware with ISS systems in preparation for when the Dragon spacecraft docks. The UHF CUCU will provide communication between the ISS, SpaceX's Dragon spacecraft, and the ground systems. The unit allows crew at mission control and aboard the ISS to monitor the spacecraft's progress as it approaches the ISS and communicate with the spacecraft's navigation to adjust its course as it maneuvers to dock.

For more about the Commercial Crew and Cargo Program, go to *www.nasa.gov/offices/c3po/home/index.html*.

Goal 6: Establish a lunar return program having the maximum possible utility for later missions to Mars and other destinations.

Responsible Mission Directorates: Exploration Systems and Space Operations

The first step toward returning human explorers to the Moon is using robotic missions to gather information about potential landing sites and available resources. The LRO mission, launched with LCROSS on June 18, finished testing and calibration in September and began mapping the Moon's south pole from its orbit only 31 miles above the lunar surface.



Credit: NASA/JPL/UCLA

Credit: NASA/Arizona State University

The Moon's South Pole remains constantly cold, as shown in daytime (left) and nighttime temperature observations recorded by LRO's Diviner. Temperatures on the Moon are some of the most extreme in the solar system. Noontime surface temperatures near the lunar equator are hotter than boiling water, while nighttime surface temperatures are almost as cold as liquid oxygen. It has been estimated that near the lunar poles, in areas that never receive direct sunlight, temperatures can dip to within a few tens of degrees of absolute zero. Much of the interior of crater Erlanger (inset image), located in the south polar region, remains in permanent shadow providing an environment for cold trapping volatiles and will be a target of interest for LRO scientists.

In July, the LRO camera took high resolution photos of the Apollo landing sites. The images showed the lunar landers, experiment packages, and the footpaths left by the Apollo astronauts.

By mid-September, one of LRO's instruments, the Diviner Lunar Radiometer Experiment, had obtained enough data to characterize the Moon's current thermal environment. It measured extremely cold temperatures within the permanently shadowed regions of large polar impact craters, among the coldest temperatures measured for any body in the solar system, including Pluto.

For more on Exploration Systems programs, go to *www.nasa.gov/exploration/home/index.html*.

Other Agency Successes

Human Capital Management

The Office of Human Capital Management (OHCM) is implementing a new program called Early-Career Hiring Initiative to increase the number of people hired for entry-level and early-career positions. This program helps ensure a long sustainable workforce. These particular positions are filled with "fresh-outs," or people who have completed bachelors, masters, or doctorate degrees less than three years ago. OHCM has authorized 173 positions for early-career engineers, scientists, and support personnel. As part of this effort to attract and retain fresh-outs, our Centers have begun initiatives such as the Dryden Flight Research Center's new professionals group to engage junior employees, the Langley Research Center's mentoring program designed to connect employees and foster career development, and the Goddard Space Flight Center's "Spacebook" (modeled after the popular Facebook social network site) to improve communication.

Inspiring Young and Diverse Scientists

The Office of Education works to build and strengthen a well-qualified and diverse future workforce for NASA and the Nation. However, Native Americans are an audience historically underserved and underrepresented in science, technology, engineering, and mathematics (STEM) college majors and careers. Traditional approaches for engaging students in STEM areas, like offering individual internships at our Centers or with aerospace partners, have not significantly increased interest among Native American students. This is due in part to differences in financial resources, family obligations, and culture. We have introduced a new approach that provides research opportunities enabling these students to interact with our scientists and technologies in ways that honor their culture, sidestep financial and relocation issues, and begin building the numbers of Native Americans working in STEM fields.

Credit: United Tribes Technical College

A student in North Dakota collects samples of an invasive plant species as part of a hands-on project. Students presented their work to NASA scientists at one of several national meetings such as the Tribal College Forum. The opportunity to network with peers and professional role models is a known motivator for student performance and encourages them to pursue STEM careers. In the inset photo, as student stands with his poster presentation at the AIHEC National Conference.

Credit: United Tribes Technical College

NASA's Minority University Research and Education Program piloted an "externship" as a new component to the Summer Research Experience activity for students and faculty of Tribal Colleges and Universities (TCUs). This twist on a classic internship brings NASA science and technologies to tribal college students rather than taking the students away from their home environment. The initial three weeks of the 10-week experience were conducted at United Tribes Technical College in North Dakota, a location within commuting for most of the participating students. The remaining seven weeks were spent conducting research at the students' home institution. This arrangement removed the burden of leaving their families. Twenty-one students and seven faculty representing nine TCUs participated in the externship pilot.

The externship was led by NASA scientists in collaboration with partners from the U.S. Geological Survey, the University of New Hampshire, and Tribal Scholars who provided Native American students and faculty members with training related to NASA Earth Science research. Participants received specialized training in the fundamentals of the scientific method,

indigenous knowledge, remote sensing, geospatial technologies, and climate change. The faculty and students used NASA tools and techniques, such as CanSat, Landsat and Lidar technologies, to conduct environmental and climate change research on their tribal lands, focusing on topics of local and cultural interest, such as drought, wetlands conservation, management of sacred lands, restoring habitats of indigenous plants, and controlling invasive species. Students who participated in the externship presented their work to NASA scientists at one of several national meetings such as the Tribal College Forum and the American Indian Higher Education Consortium (AIHEC) National Conference. The ability to network with peers and professional role models is a known motivator for student performance and pursuit of STEM careers.

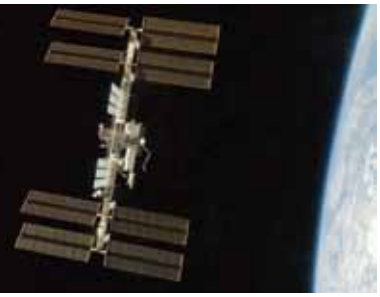
Verification and Validation of NASA's Performance Data

We verify and validate our performance data to assure Congress and the public that reported performance information is credible. We have verified and validated that NASA's Mission Directorates and Mission Support Offices have established procedures for collecting, maintaining, and processing accurate GPRA performance data.

Each Mission Directorate and Mission Support Office has a process in place for assessing performance and assigning ratings to their Outcomes and APGs. NASA program officials enter supporting performance information into a secure Web-based system, which stores the information during and after the annual performance reporting process. Analysts within NASA's Office of Program Analysis and Evaluation (PA&E) conduct additional reviews and evaluations of reported performance data to assess whether the information submitted by the Mission Directorates and Mission Support Offices is consistent with information reported at other internal reviews and complete enough to portray an accurate picture of NASA's performance.

In FY 2009, PA&E surveyed the Mission Directorates and Mission Support Offices on their verification and validation procedures via the secure web-based system during the annual PAR data collection process. The survey required Mission Directorate and Mission Support Office officials to provide information about their processes for rating program performance, and maintaining and verifying data. PA&E analysts reviewed the survey results and conducted follow-up interviews during which officials provided documentation to prove the effectiveness and completeness of their performance information collection and storage processes. The PA&E analysts verified that each office has sufficient procedures in place to certify that their performance data is free of anomalies. This process enabled PA&E to capture snapshots of verification and validation processes across the Agency. PA&E will share best practices with the Mission Directorates and Mission Support Offices to improve their internal performance management systems.

Financial Results



This section analyzes and discusses NASA's Financial Statements and the Agency's stewardship of the resources provided to it by Congress to carry out its mission. The Financial Statements, which present the results of the Agency's operations and financial position, are the responsibility of NASA's management.

The Agency's financial statements and accompanying notes are presented in their entirety in the *Financials* section. NASA prepares the Consolidated Balance Sheet, Consolidated Statement of Net Cost, Consolidated Statement of Changes in Net Position and Combined Statement of Budgetary Resources statements, which provide the financial results of the Agency's operations. This overview focuses on the key information provided in the statements, which describes NASA's stewardship of the resources provided to it by Congress to carry out its mission.

Financial Highlights

Results of Operations

NASA's net cost of operations for FY 2009 was $22.5 billion, an increase of $4.1 billion, or twenty-two percent from FY 2008. Each of the Agency's Business Lines experienced an increase in net cost as the Agency emphasized programs essential to achieving various Strategic Goals.

NASA's programs and activities are carried out through four Business Lines: Aeronautics Research, Exploration Systems, Science, and Space Operations. The Consolidated Statement of Net Cost presents the Agency's net costs by Business Lines, which is summarized in the table on the next page. The net cost of operations is the gross (total) cost incurred by the Agency, less any earned revenue for work performed for other government organizations or for the public.

Space Operations, which includes the Shuttle and International Space Station programs, at $10.6 billion, and Science, at $6.0 billion, were the Agency's largest business lines in FY 2009. The accompanying table provides net cost comparisons for FY 2009 and FY 2008 across the Agency's four major business lines.

Cost by Business Line

(Dollars in Millions)

Line of Business	Unaudited 2009	Unaudited 2008	% Change
Aeronautics Research			
Gross Costs	$ 828	$ 779	6%
Less: Earned Revenue	113	86	31%
Net Costs	**715**	**693**	**3%**
Exploration Systems			
Gross Costs	5,153	4,811	7%
Less: Earned Revenue	33	28	18%
Net Costs	**5,120**	**4,783**	**7%**
Science			
Gross Costs	6,606	6,392	3%
Less: Earned Revenue	616	511	21%
Net Costs	**5,990**	**5,881**	**2%**
Space Operations			
Gross Costs	11,070	7,449	49%
Less: Earned Revenue	428	418	2%
Net Costs	**10,642**	**7,031**	**51%**
Net Cost of Operations			
Gross Costs	23,657	19,431	22%
Less: Earned Revenue	1,190	1,043	14%
Net Costs	**$ 22,467**	**$ 18,388**	**22%**

A significant portion of the increase in net costs relates to general costs for goods and services used in operations across all NASA programs, with the majority for the International Space Station (ISS). The remaining costs are allocated to all lines of business.

Aeronautics Research net costs increased $22 million or three percent in FY 2009. Significant progress was made towards implementing the Next Generation Air Transportation System (NextGen), which is intended to yield revolutionary concepts, capabilities and technologies that will enable significant improvements in air traffic management.

Exploration Systems net costs were $337 million or seven percent higher in FY 2009 primarily due to increased activity to develop the Orion Crew Exploration Vehicle as the next-generation, piloted spacecraft to bring into service after the planned Shuttle retirement in 2010, and the Ares I launch system and infrastructure to support the Nation's space exploration goals by the year 2015. In 2009, the Lunar Crater Observing and Sensing Satellite mission (LCROSS) launched the Lunar Centaur and Spacecraft to the Moon, impacting the lunar surface for the purpose of investigating the possible presence of water in a permanently shadowed crater.

Science net costs increased $109 million or two percent in FY 2009. The Agency moved forward on several projects, including the Juno mission to conduct in-depth study of the planet Jupiter, which is scheduled to launch in 2011, and the Gravity Recovery and Interior Laboratory (GRAIL) project to determine the structure of the lunar interior and understanding of the evolution of the Moon. Components of Science costs decreased in 2009 with the transfer of the Deep Space Network (DSN) system, which enables continuous communication to spacecraft as the Earth rotates, from the Science line of business to the Space Operations line of business. Mars Science Laboratory operations stabilized, and 2009 costs were lower compared to 2008, as progress continued on the development of NASA's third-generation of rover to explore the red planet, which is scheduled for launch in 2011.

Space Operations net costs increased $3.6 billion or fifty-one percent in FY 2009, primarily because of activities to complete the ISS. All Space Shuttle missions will be completed by the end of 2010, after which the Space Shuttle orbiters are scheduled to be retired. Spacecraft Operations completed activities to sustain engineering support and an increase in vehicle replacement spare parts, which will be essential once the Shuttle orbiters have been retired since there will not be return or repair capability. Space Operations also made significant progress on the Tracking and Data Relay Satellite (TDRS) Replenishment project to replenish the aging fleet of communications spacecraft in the space network.

Sources of Funding

NASA receives funds to support its operations primarily through Congressional appropriations. NASA's funds available for use in FY 2009 totaled $21.3 billion, compared to $20.9 billion in FY 2008, an increase of $349 million. NASA's total budgetary resources come from various sources, as illustrated in the table below.

Available Budgetary Resources
(Dollars in Millions)

Line Item	Unaudited 2009	Unaudited 2008	% Change
New Budget Authority	$ 18,786	$ 17,373	8%
Unobligated Balance Brought Forward (Available)	814	2,402	-66%
Other Resources Available	1,696	1,172	45%
Total Available Resources	**$ 21,296**	**$ 20,947**	**2%**
Total Obligations Incurred	20,166	20,161	0%
Total Remaining Resources as of September 30	**$ 1,130**	**$ 786**	**44%**

New Budget Authority, which represented 88 percent of NASA's available resources in FY 2009, was provided by Congress primarily through two-year appropriations. New budget authority increased by eight percent, or $1.4 billion, in FY 2009. This included $1 billion in funding to NASA through the American Recovery and Reinvestment Act of 2009 (Recovery Act) to achieve the Space Program objectives listed in the table below. Details on NASA's progress are available at *www.nasa.gov/recovery/index.html*.

American Recovery and Reinvestment Act of 2009
(Dollars in Millions)

Operation	Funds Received	Objective
Cross Agency Support	$50	• To restore NASA-owned facilities damaged from hurricanes and other natural disasters occurring during calendar year 2008
Science	400	• To accelerate the development of the Tier 1 set of Earth Science climate research missions recommended by the National Academies Decadal Survey • To increase the Agency's supercomputing capabilities
Exploration Systems	400	• To develop Constellation Systems to narrow the gap in U.S. human space flight capabilities between the 2010 retirement of the Space Shuttle and the 2015 launch of its replacement.
Aeronautics Research	150	• To undertake systems-level research, development and demonstration activities related to: – Aviation safety – Environmental impact mitigation – The Next Generation Air Transportation System (NextGen)
Inspector General	2	• To provide oversight of NASA's implementation and execution of the Recovery Act and the requirements of the Office of Management and Budget's implementing guidance
Total	**$1,002**	

Unobligated Balance, Brought Forward represents budget resources remaining at the prior fiscal year-end that are available for use in the current fiscal year. Budget resources remaining at the end of FY 2009 that will be available for use in FY 2010 were $1.1 billion and primarily represent Recovery Act funding ($600 million) not yet obligated. Recovery Act funding was provided through two-year appropriations, and various initiatives are scheduled for completion in fiscal year 2010.

Other Resources includes funding received for sharing NASA technology and services provided to other Federal agencies and public entities, and recoveries of budget resources that were obligated in a previous year. Other Resources increased 45 percent in FY 2009 primarily for work performed for other government agencies, such as Department of Air Force for the Tracking and Data Relay System (TDRS), and the National Oceanic and Atmospheric Administration (NOAA) for the Polar Operational Environmental Satellites (POES) and Geostationery Operational Environmental Satellite (GOES) projects.

Obligations Incurred represents NASA's use of $20.2 billion of available budget resources to accomplish the Agency's goals within its four Major Business Lines: Aeronautics Research, Exploration Systems, Science, and Space Operations. Obligations Incurred between FY 2009 and FY 2008 was relatively flat. Obligations Incurred represented a use of 95 percent of Total Available Resources in FY 2009, compared to 96 percent in FY 2008.

Balance Sheet

Assets

Total assets as of September 30, 2009 were $23.7 billion, a decrease of $3.6 billion compared to September 30, 2008. NASA's assets are divided into four categories, as described in the table below.

Agency Assets
(Dollars in Millions)

Line Item	Unaudited 2009	Restated Unaudited 2008	% Change
Property, Plant, & Equipment	$ 11,577	$ 15,028	-23%
Fund Balance with Treasury	8,854	9,292	-5%
Inventory	3,019	2,883	5%
Other Assets	235	93	153%
Total Assets	**$ 23,685**	**$ 27,296**	**-13%**

NASA's largest category of assets is **Property, Plant & Equipment (PP&E)**, which decreased twenty-three percent, or $3.5 billion, in FY 2009. Space Exploration PP&E represents 77 percent of total PP&E and consists mainly of assets supporting the ISS. In FY 2009 NASA prepared for the anticipated fiscal year 2010 application of Statement of Federal Financial Accounting Standards (SFFAS) 35, *Estimating the Historical Cost of General Property, Plant, and Equipment—Amending Statements of Federal Financial Accounting Standards 6 and 23*. As part of its preparation, NASA performed an analysis of the methodology used to account for the historical cost of ISS. Based on that analysis, the PP&E account balances for ISS were adjusted to reflect an estimated cost.

Fund Balance with Treasury (FBWT), which represents our cash balance at the Department of Treasury, decreased $438 million. In addition to its normal appropriation, NASA received $1 billion funding through the Recovery Act.

Inventory and Related Property, increased by $136 million due to the completion of the external tanks to be used during Shuttle launches.

Other Assets includes Investments at $17 million and Accounts Receivables at $218 million in FY 2009. Accounts Receivable increased by $142 million due to work performed for NOAA and the Department of the Air Force that was not collected as of September 30, 2009.

Liabilities

Total liabilities as of September 30, 2009, were $4.1 billion, a decrease of $99 million compared to September 30, 2008. The major categories of liabilities are detailed in the table below.

Agency Liabilities
(Dollars in Millions)

Line Item	Unaudited 2009	Unaudited 2008	% Change
Accounts Payable	$ 1,384	$ 1,517	-9%
Other	1,786	1,724	4%
Environmental and Disposal Liabilities	922	943	-2%
Federal Employee and Veterans Benefits	57	64	-11%
Total Liabilities	**$ 4,149**	**$ 4,248**	**-2%**

Accounts Payable represents amounts owed for goods and services received that are due to other entities and accounted for the majority of the decrease in liabilities, $133 million, relating to normal business operations.

Other Liabilities represents estimated contractor costs incurred but not yet paid, as well as contingent liabilities for litigation claims, accrued payroll and related costs and liability for advances and prepayments.

Environmental and Disposal Liabilities are estimated cleanup costs for actual or anticipated contamination from waste disposal methods, leaks, spills, and other NASA activity that created or could create a public health or environmental risk, and total cleanup costs associated with the removal, containment, and/or disposal of hazardous wastes or material and/or property that have been deferred until operation of associated PP&E ceases either permanently or temporarily. The estimate represents the amount that NASA expects to spend for the remediation of currently known contamination or for cleanup costs at the time an asset is removed from service. This estimate could change in the future due to the identification of additional contamination, inflation, deflation, or changes in technology or applicable laws and regulations. The estimate will also change through ordinary liquidation of these liabilities as cleanup programs progress.

Federal Employee and Veteran Benefits are amounts that NASA estimates for future worker's compensation liabilities for current employees. The estimate for future worker's compensation benefits includes the expected liability for death, disability, medical and miscellaneous costs for approved compensation cases, plus a component of incurred but not reported claims.

Net Position

Net Position represents the sum of Cumulative Results of Operations and Unexpended Appropriations. Net Position is the current value of the Agency's assets less its liabilities. The Agency Net Position decreased by $3.5 billion.

Limitations of the Financial Statements

The principal financial statements have been prepared to report the financial position and results of operation of NASA, pursuant to the requirements of 31 U.S.C. 3515 (b). While the statements have been prepared from the books and records of NASA in accordance with Generally Accepted Accounting Principles (GAAP) for Federal entities and the formats prescribed by the Office of Management and Budget (OMB), the statements are in addition to the financial reports used to monitor and control budgetary resources, which are prepared from the same books and records.

The statements should be read with the realization that they are for a component of the U.S. Government, a sovereign entity.

Systems, Controls, and Legal Compliance

Management Assurances: Administrator's Statement of Assurance

November 16, 2009

NASA management is responsible for establishing and maintaining effective internal control and financial management systems that meet the objectives of the *Federal Managers' Financial Integrity Act* (FMFIA) as well as related laws and guidance. NASA is committed to a robust and comprehensive internal control program. We recognize that ensuring the effective, efficient, and responsible use of the resources that have been provided to the Agency is not only good stewardship, but also the right approach to maximizing our progress toward the realization of our goals. Within the Agency, I have made it clear that I am responsible for establishing and maintaining a sound system of internal control. In turn, I have made these responsibilities clear to my program management, Mission Support Offices, and Center management—and they have communicated this responsibility to their subordinates. As a result, managers and employees throughout the Agency are active on a daily basis in identifying or updating key control objectives, assessing risks, implementing controls or other mitigating strategies, conducting reviews, and taking corrective actions as necessary. In addition, NASA's basic governance structure—as represented by the Strategic Management Council, Program Management Council, and Operations Management Council—provides both the top-level guidance and the integration required to ensure our internal control program is operating effectively.

The Office of Internal Controls and Management Systems (OICMS) is the functional lead for NASA's internal control program, except for the internal controls over financial management and reporting, which are the responsibility of the Office of the Chief Financial Officer (OCFO), as further described below. During the past year, OICMS has taken significant steps to strengthen NASA's internal control program, focusing on improving the Statement of Assurance (SoA) self assessment process. OICMS developed and implemented the Internal Control Evaluation Tool (ICET), an internal control database management system. The ICET was used Agency-wide as an information system for each organization to complete and submit results of their internal control self assessment. The ICET has provided each NASA Headquarters (HQ) and Center organization with an information system to document programmatic and institutional key work activities, major risks, and primary controls to mitigate risk. Users evaluated results of self-assessments of the effectiveness of primary controls identified and rated the control effectiveness according to a red/yellow/green score.

The Fiscal Year (FY) 2009 SoA process also included a new acquisition assessment survey in response to a memorandum by the Office of Management and Budget (OMB) to provide guidelines for conducting internal control reviews of the acquisition function. An acquisition survey was developed and completed by senior management, program/project managers of major programs, and procurement officials to provide cross-cutting reviews of the acquisition process at NASA. In FY 2009, the OICMS also completed quality assurance reviews over the Statement of Assurance process for all HQ and Center organizations.

The OCFO establishes and maintains the internal controls over financial reporting and assesses and reports on the efficiency and effectiveness of those controls. The OCFO performs an annual review in compliance with OMB Circular A-123, Appendix A, *Internal Control Over Financial Reporting*, to support management's assertion on the

internal controls over financial reporting. The review entails an assessment of the design and operating effectiveness of key internal control activities for select business cycles, for safeguarding of assets, and for compliance with applicable laws and regulations. The OCFO follows a risk-based approach in determining the business cycles to be assessed during the current year, and each cycle is assessed at least once every three years. During FY 2009, the Agency's fund balance with Treasury, personal property, procurement and payment management, and revenue and receivables management cycles were assessed. In addition, the FY 2009 assessment focused on the operating effectiveness of the key controls of the accounts payable, accounts receivable, and fund balance with Treasury functions that transitioned to the NASA Shared Services Center. No new material weaknesses were identified as a result of the A-123-A work performed.

I am very pleased to report that the OCFO has implemented remedial actions necessary to resolve one of the two prior year material weaknesses. The successful remediation of the prior year material weakness in Financial Systems, Analyses, and Oversight resulted from improvements achieved through rigorous adherence to the Comprehensive Compliance Strategy, NASA's framework for ensuring compliance with Generally Accepted Accounting Principles and other financial requirements. These efforts included a more robust Continuous Monitoring Program over financial operations, progress toward substantial compliance with the *Federal Financial Management Improvement Act* (FFMIA), and resolution of intra-governmental issues with significant trading partners. While recognizing that this material weakness, outstanding for several years, has now been remediated, the OCFO will remain diligent in seeking ways to further improve financial management operations and Agency performance.

The Agency continued to make significant progress on NASA's one remaining material weakness—Controls over Legacy Property, Plant and Equipment (PP&E), related to valuation of legacy assets. The Agency believes it has now achieved compliance with the applicable updated accounting standard issued in October 2009 with respect to this class of assets. During FY 2009, the OCFO revised the estimated value of Legacy PP&E in anticipation of the pending release of the new accounting standard that allows estimating certain historical PP&E values reported in financial statements. While the Federal Accounting Standards Advisory Board (FASAB) has released Statement of Federal Financial Accounting Standards (SFFAS) 35, *Estimating the Historical Cost of General Property, Plant, and Equipment*, it was issued subsequent to the fiscal year end, and there was no provision for the retroactive application of the new standard. Although NASA was unable to demonstrate compliance under the prior standard for FY 2009, its Legacy PP&E valuation has been updated using alternatives under the new applicable standard.

With respect to the overall adequacy and effectiveness of internal control within the Agency, I hereby submit a qualified Statement of Assurance that NASA's internal controls and financial management systems meet the objectives of FMFIA, based on the fact that NASA's previously reported material weakness, Controls over Legacy PP&E, remained outstanding as of September 30, 2009. NASA also conducted its assessment of internal control over the effectiveness and efficiency of operations and compliance with laws and regulations in accordance with OMB Circular A-123, *Management's Responsibility for Internal Control*. I am pleased to report that no material weaknesses were identified during the past year's assessment of internal control over operations. Therefore, concerning the effectiveness of internal control over operations as of September 30, 2009, I am submitting an unqualified statement of assurance. However, due to the continuing material weakness in Controls over Legacy PP&E, I am submitting a qualified statement of assurance that the Agency's internal controls over financial reporting as of June 30, 2009, were operating effectively.

In accordance with the requirements of FFMIA, management is responsible for reporting on its implementation and maintenance of financial management systems that substantially comply with federal financial management systems requirements, applicable federal accounting standards, and the U.S. Government Standard General Ledger (SGL) at the transaction level. In FY 2009, NASA made significant progress toward substantial compliance with FFMIA. We use the Comprehensive Compliance Strategy and the Continuous Monitoring Program to ensure that financial management functions and activities are in compliance with Federal accounting standards, the U.S. SGL, and other applicable statutes, laws, regulations, and administrative guidelines. NASA's financial statements are prepared using information generated by the core financial system consistent with OMB Circular A-136, *Financial Reporting Requirements*, and the Agency's financial systems provide timely and reliable financial information. However, the Agency was unable to demonstrate substantial compliance with regard to (i) meeting some system access and change management controls, and (ii) fully integrating certain subsidiary systems, including some property systems, with the Agency's Core Financial Module. As a result, I consider NASA's financial management systems not substantially compliant with the requirements of FFMIA as of September 30, 2009.

As stated above, no new material weaknesses were identified, and one material weakness was resolved this past year. NASA will continue to work to ensure that its internal control program prevents new material weaknesses from developing. As required, we are also providing below a status report on the remaining material weakness, including progress made on corrective actions during the past year and planned actions for the coming year.

Charles F. Bolden, Jr.
Administrator

NASA's Material Weaknesses and Non-Conformances

Remediation Program for Continuing Material Weaknesses

NASA continues to report Controls over Legacy Property, Plant and Equipment (PP&E) as a material weakness. NASA's estimation methodology for Legacy PP&E under the new Statement of Federal Financial Accounting Standards (SFFAS) 35, *Estimating the Historical Cost of General Property, Plant, and Equipment*, standard released by the Federal Accounting Standards Advisory Board (FASAB) October 14, 2009, will be evaluated in FY 2010. The prior year material weakness related to Financial, Systems Analyses, and Oversight has been resolved. The following chart shows NASA's prior year material weaknesses and significant remedial actions taken this fiscal year.

Controls Over Legacy Property, Plant & Equipment (PP&E)	
Material Weakness Description	The Financial Statement Auditor indicated . . . "Property, Plant & Equipment identified serious weaknesses in the design of the internal controls over the completeness and accuracy of legacy assets which prevented material misstatements from being detected and corrected in a timely manner by NASA. Certain legacy issues noted in prior-year audit reports continue to challenge the Agency, particularly in relation to the International Space Station (ISS) and Space Shuttles." (Agency Financial Report, PAR).
Significant Actions Taken in FY 2009	During FY 2009, the OCFO revised the estimated value of Legacy PP&E in anticipation of the pending release of the new accounting standard SFFAS 35, *Estimating the Historical Cost of General Property, Plant, and Equipment* that allows estimating certain historical PP&E values reported in financial statements. While the FASAB has released SFFAS 35, it was issued subsequent to the fiscal year end, and there was no provision for the retroactive application of the new standard. NASA also: • Continued adherence to Capitalization Policy, NPR 9250.1, "*Property, Plant and Equipment and Operating Materials and Supplies*," effective October 1, 2007, and developed procedures to ensure that the identification of capital assets occurs at the time of acquisition. These procedures apply to new contracts and acquisitions beginning on or after October 1, 2007. • Continued full integration of the Asset Accounting module within the core financial system to record, track, monitor and value NASA capitalized personal property; and • Strengthened Continuous Monitoring Program (CMP) oversight of Property Plant & Equipment and implemented CMP Clinics to discuss exceptions, Center best practices, and provided real time training.
Anticipated Actions in FY 2010 and Beyond	NASA will continue to implement its capitalization policy on new PP&E and apply SFFAS 35 estimation methodology for its legacy PP&E.
Financial Systems Analyses and Oversight	
Material Weakness Description (Resolved)	NASA management and auditors identified weaknesses in the entity-wide internal control that impaired NASA's ability to report accurate financial information on a timely basis.
Significant Actions Taken in FY 2009	In FY 2009 OCFO completed implementation of remediation actions necessary to resolve the Financial Systems, Analyses, and Oversight material weakness. The successful resolution resulted from improvements achieved through adherence to the Comprehensive Compliance Strategy (CCS), NASA's framework for ensuring compliance with generally accepted accounting principles and other financial requirements. These efforts include: • Implemented a more robust Continuous Monitoring Program (CMP) over financial activities. • Made progress toward substantial compliance with the *Federal Financial Management Improvement Act* (FFMIA). • Developed Environmental Liability estimate for decommissioning costs in compliance with SFFAS 6, *Property, Plant and Equipment*. • Revised environmental liabilities estimating policy. • Improved communication with Office of the General Council and Chief Financial Officer regarding contingencies. • Coordinated with the Department of Treasury Intra-governmental Action Team to resolve Trading Partner differences.
Anticipated Actions in FY 2010 and Beyond	The Financial, Systems Analyses, and Oversight material weakness has been resolved and will no longer be reported. Although this prior year material weakness has been addressed, OCFO will continue the improvements implemented and monitor performance.

The Office of Inspector General's FY 2009 Management Challenges

NASA's Office of Inspector General (OIG), an independent entity, evaluates the programs and operations. The OIG submits an annual update of the most serious management challenges facing NASA.

We are committed to addressing these major management challenges. Using OIG's perspective as a catalyst, we will develop and implement the changes necessary to improve agency operations. Several key management challenges identified by the Office of the Inspector General are:

- Transitioning from the Space Shuttle to the Next Generation of Space Vehicles
- Managing Risk to People, Equipment, and Mission
- Financial Management
- Acquisition and Contracting Processes
- Information Technology Security

In FY 2010, the OIG will conduct work that focuses on efforts to meet these challenges as part of an overall mission to promote the economy and efficiency of the Agency.

The Government and Accountability Office's (GAO) High Risk List

NASA has been on the GAO High-Risk List in the area of Contract Management since 1990, when the first High-Risk List was published. In the most recent GAO update to the High-Risk List, issued in January 2009, GAO changed the title of this High-Risk item from Contract Management to Acquisition Management, acknowledging the broad scope of issues being addressed. As of January 2009, GAO noted that NASA has made a concerted effort to improve and has made important advances, but added that it will take several years for the Agency to fully implement its High-Risk initiatives.

The NASA initiatives are identified in a comprehensive Corrective Action Plan that meets Office of Management and Budget (OMB) requirements. Successful implementation of both the plan and revised policies should stem cost growth and schedule slippage. Additional information is available at *www.nasa.gov/budget*.

Looking Forward

NASA charged the Human Spaceflight Program Committee, chaired by Norman Augustine, with conducting an independent review of our current human spaceflight program and providing alternatives that would ensure that "the [N]ation is pursuing the best trajectory for the future of human spaceflight—one that is safe, innovative, affordable and sustainable." The report provides the Nation and the Obama Administration with a thoughtful and comprehensive review of our past achievements and current path for exploring low Earth orbit and beyond.

As the Agency works with this Administration on how best to implement the far-reaching implications of the Augustine Committee Report, we must also stay focused on our near-term commitments.

Over the next year, the Space Shuttle will fly a series of missions that will complete its role in readying the International Space Station (ISS) for sustained operations. While its final mission is planned for the end of 2010, the Shuttle remains a recognizable symbol of U.S. engineering and scientific achievement, and its legacy will last far into the future. During the Space Shuttle's lifetime, astronaut crews have used the Shuttle to deploy dozens of space and Earth science missions, and service spacecraft on orbit, including the Hubble Space Telescope, using its unique capabilities.

Through the past few Shuttle missions, the ISS life support capacity has been increased, and six people can now live and work on this unique facility. The expanded crew will continue to pursue the benefits of the ISS as an ongoing test bed for exploration technology development and demonstration, and continue developing the U.S. segment of the ISS as a national laboratory for use by other Federal entities and the private sector.

Credit: NASA

In past years the ISS could only accommodate extra crew as temporary visitors while a spacecraft was visiting. Now, with upgrades in place, the ISS is equipped to house six crewmembers. In this photo crewmembers share a meal near the galley in the Zvezda Service Module. Pictured from the left are NASA astronaut Michael Barratt, Expedition 19/20 flight engineer; European Space Agency astronaut Frank De Winne, Expedition 20 flight engineer and Expedition 21 commander; Russian cosmonaut Gennady Padalka, Expedition 19/20 commander; Canadian Space Agency astronaut Robert Thirsk, Expedition 20/21 flight engineer; and NASA astronaut Jeffrey Williams, Expedition 21 flight engineer and Expedition 22 commander; along with NASA astronaut Nicole Stott, Expedition 20/21 flight engineer.

In science, several exciting new Earth Science missions will yield practical knowledge and innovative technologies for studying climate change and weather. Operation ICE Bridge, an airborne campaign, will measure changes in polar ice sheets to augment satellite observations of ice sheets in critical locations including Greenland, Antarctica, and Alaska. The launch of the GPM mission will improve ongoing efforts to predict climate, weather, and rainfall. Finally, the Global Hawk Unmanned Aerial Vehicle will begin collecting atmospheric data to add to NASA's Earth Science analyses. Autonomous aircraft systems, like Global Hawk, are already improving and advancing hurricane monitoring techniques, and disaster support capabilities worldwide.

In aviation, as the number of flight operations at our Nation's largest airports increases, noise and emissions present environmental concerns that limit the capacity of those airports, and in turn, the entire air transportation system. In an attempt to mitigate growing noise and emission concerns, a new program within NASA Aeronautics Research will begin to assess and demonstrate,

at an integrated systems-level, promising concepts and technologies to enable a reduction in fuel consumption, as well as noise and local and global emissions to lessen harmful environmental impacts of the Nation's growing air transportation system.

As current and future work results in new capabilities, knowledge, and technologies, it is part of NASA's mission to share these advances with the Nation. Through this access, entrepreneurs, industry, academia, and other government agencies, are encouraged to innovate in ways that can help address national and global challenges, including increased interest for education in science and engineering fields, economic vitality, and stewardship of Earth.

Credit: NASA

NASA's P-3 aircraft flies over a frozen airfield in Thule, Alaska, as part of Operation ICE Bridge, a mission that is providing polar ice observations between ICESat I, which will end operations in 2009, and ICESat II, which is in formulation.